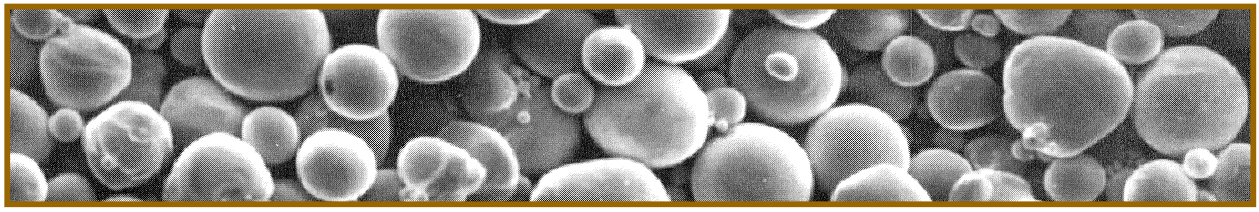
Purdue University
School of Materials Engineering

MSE 512 Powder Processing Fall 2017



Instructor Prof. Kevin Trumble, ARMS 2333, 494-4114, driscol@purdue.edu
Lecture MWF 9:30 WANG 2555

Description Developed with support from the National Science Foundation, this course is one of a series of general, microstructure-based materials processing courses offered by the School of Materials Engineering. Although the course emphasizes applications in engineering materials (ceramics, metals, polymers, and composites), substantial portions of the course are generic to pharmaceutical, chemical, biological, and agricultural applications.

Objectives To develop a framework for quantitative analysis of powder processing in terms of the chemistry, physics, and mechanics principles governing the behavior of particulate. To recognize the capabilities and limitations of powder processing relative to other types of processing for producing specific shapes (macrostructures) and controlled internal structure (microstructures). To become conversant in the research literature in powder processing.

Prerequisites Senior or graduate standing in engineering, science, or related disciplines.

Required Text
R.J. Hunter, Introduction to Modern Colloid Science, (pbk) Oxford (1994). ISBN 0198553862

References (not required)
J. N. Israelachvili, Intermolecular and Surface Forces, 3rd ed. (2011), Academic Press.
R. M. German, Powder Metallurgy and Particulate Materials Processing, Metal Powder Industries Federation (2005).
J. S. Reed, Principles of Ceramics Processing, 2nd ed. (1995) Wiley.

Grading Graded homework due every 2 to 3 weeks, a midterm exam, a comprehensive final exam, a short paper and presentation on powder production and a modest paper on a particular powder process or phenomenon of the student's choice.

Homework sets (5)	10%
Powder Production Paper/Presentation	10%
Midterm exam (October 16)	25%
Powder Processing Paper	20%
Final exam (TBA)	35%

The +/- grading option will be used in assigning final letter grades for the course.

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Recorded lecture access

MSE 512 is running online in Fall 2017. All lectures will be recorded for streaming to the students off campus. The lecture video recordings will also be available to on-campus students to view any time by logging in from a Purdue University IP address:

The URL is https://engineering.purdue.edu/ProEd/OnCampus
Course Login ID Number –**9999913198**
Course – MSE51200
The URL for distance students is
https://engineering.purdue.edu/ProEd/current_student.

Emergency Procedures

Fire, weather, and civil emergency procedures specific to the WANG 2555 will be reviewed in class. Information on emergency preparedness at Purdue is available on the Purdue homepage and at http://www.purdue.edu/emergency_preparedness/. For a shelter-in-place siren (tornado, hazardous material release, civil disturbance) we will stay in WANG 2555 and wait for further instructions. In case of a fire alarm, we will exit WANG via the stairway and assemble in the Northwestern Ave parking garage.

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. These changes would be posted on the course website on *Blackboard*.

In case of an extended disruption in which classes on campus are suspended the course will continue to the extent possible via *Blackboard*. If you do not have access to *Blackboard* (the internet) from off campus, please inform Prof. Trumble by e-mail so that alternate plans for communication can be made in case classes are suspended.

Academic Dishonesty Policy

Purdue University Regulations, Part 5, Section III-B-2-a describes the formal policies governing academic dishonesty. A guide providing specific examples, tips, and consequences is available at http://www.purdue.edu/odos/osrr/academic-integrity/index.html. You are encouraged to work to together and discuss concepts and general approaches to the homework problems but the solutions you turn in for grading are expected to be your own original work.

MSE 512 Powder Processing

Brief Outline

1. Introduction

2. Particulate production and characterization
   - 2.1 Production
     - comminution, atomization, chemical precipitation, etc.
   - 2.2 Characterization
     - morphology, surface area
     - size distribution measurement (sieving, sedimentation, light scattering)
     - agglomerates, density and porosity measurement (pycnometry, porosimetry)

3. Particle interactions
   - 3.1 basic colloidal chemistry
   - 3.2 DLVO theory
   - 3.3 dispersion and flocculation
   - 3.4 colloidal gels

---------- Midterm ----------

4. Consolidation
   - 4.1 Particle packing (regular and irregular)
   - 4.2 Dry consolidation
     - additives and preparation (e.g. granulation)
     - shaping methods (pressing, etc.)
   - 4.3 Wet consolidation
     - rheology and consolidation of slurries and pastes
     - shaping methods (e.g., slip casting, pressure filtration, injection molding)
     - drying

5. Densification and microstructure development
   - 5.1 solid state sintering
     - densification and shrinkage
     - surfaces, interfaces, and dihedral angles
     - driving forces, transport mechanisms and kinetics
     - grain growth and coarsening
     - effect of applied pressure
   - 5.2 liquid phase sintering
   - 5.3 infiltration and other densification processes